STATISTICAL ASPECT OF THE PROBLEM OF CARCINOGENESIS

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1. Introduction

The present paper is intimately related to the two preceding papers [1], [2], and is the outcome of collaboration which was broader than a mere reference would indicate. It is appropriate, then, for us to begin with acknowledging our indebtedness to the authors of the other papers, particularly to Michael B. Shimkin. Our familiarity with the problem and, more specifically, our knowledge of cancer as a biological phenomenon (which we readily admit to be of negligible extent) originate from conversations that one of us had with Shimkin, and from reading his papers written jointly with Milton Polissar. Subsequently, in the process of planning and execution of the experiments described in the two earlier papers, the present authors benefited greatly from discussion with our biological colleagues on both sides of this continent, in Philadelphia with Shimkin, and in Berkeley with White, Grendon, and Jones.

2. Different scales of study

A study of any natural phenomenon may be conducted on a variety of levels, or scales. The choice of the scale contributes considerably to the nature of questions asked and to the general character of answers attempted. In particular, in the currently conducted studies of carcinogenesis there are discernible scales that might be classified roughly as follows.

(1) *Somatic scale.* This label, the appropriateness of which we are not prepared to defend, is used to describe the studies conducted on the broadest possible level, concerned with age specific death rates from cancer, with the problem of cancer and smoking, and so forth. The characteristic feature of this scale is the absence of a closely considered mechanism which originates cancer.

(2) *Clone and cell scale.* Under this heading we include studies, like the present, in which the happenings within cells or within clones of cells, the happenings that are observed or hypothesized, are coming under explicit consideration.

(3) *Molecular biology,* which, of course, is the finest scale.

As we see it, the purposes of studies, both empirical and statistical, conducted

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